

Thesis
B353

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UNIVERSITY OF PURDUE

1931

I wish to express my sincere appreciation to Professor
A. H. Hines for his guidance and assistance in conducting
this study, and to Mr. W. L. Harrison for his assistance
in the statistical analysis. I also wish to thank the many
persons who gave up their hours of spare time to assist

**DETERMINATION OF THE EFFECT OF PERFORMING A SIMPLE TASK OVER
A PROLONGED PERIOD ON THE RATE OF ENERGY EXPENDITURE**

A Thesis

Submitted to the Faculty

of

Purdue University

by

John Henry Behl

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science in Industrial Engineering

June, 1931

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B353

RESEARCHES ON THE EFFECT OF TEMPERATURE & HUMIDITY ON THE

A THESIS SUBMITTED BY THE HON. MR. J. H. H. H. H.

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I want to express my sincere appreciation to Professor S. Tilles for his guidance and assistance in organizing this thesis, and to Dr. V. L. Anderson for his assistance in the statistical analysis. I also want to thank the nine students who gave up six hours of their time to provide the data for this thesis, and my wife for helping make it a finished product.

CONFIDENTIAL

I want to express my sincere appreciation to Professor
E. Miller for his guidance and assistance in organizing
this team, and to Dr. J. A. Jackson for his assistance
in the statistical analysis. I also want to thank the nine
students who gave up the hours of their time to provide
the data for this team, and my wife for helping with it
a limited amount.

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ABSTRACT

Although there have been numerous experiments involving the use of metabolic equipment for measuring energy expenditure during the performance of a simple task, none of these have been conducted over a prolonged continuous period. This thesis involved taking three simple tasks and finding the effect on energy expenditure of performing these tasks for sixty-four minutes without interruption. The tasks used were:

1. A seventeen inch transfer of small steel balls at a tempo of 96 one way beats per minute of a metronome.
2. A twenty-five inch motion for each arm between two points at a tempo of 160 one way beats per minute of a metronome.
3. Pedaling a bicycle, with chain disconnected, at a tempo of 138 one way beats per minute of a metronome.

The results of this thesis indicate that the energy expenditure appears to rise rapidly at the beginning of the simple task and does not change significantly for at least a period of time of sixty-four minutes.

ABSTRACT

Although there have been numerous experiments involving the use of metabolic equipment for measuring energy expenditure during the performance of a single task, none of these have been conducted over a prolonged continuous period. This thesis involved taking three simple tasks and finding the effect on energy expenditure of performing these tasks for sixty-four minutes without interruption. The tasks used were:

1. A seventeen inch diameter of small steel balls at a tempo of 60 one way beats per minute of a metronome.
2. A twenty-five inch motion for each arm between two points at a tempo of 120 one way beats per minute of a metronome.
3. Pedaling a bicycle, with chain disconnected, at a tempo of 120 one way beats per minute of a metronome.

The results of this thesis indicate that the energy expenditure appears to rise rapidly at the beginning of the single task and does not change significantly for at least a period of time of sixty-four minutes.

DETERMINATION OF THE EFFECT OF PERFORMING A SIMPLE TASK OVER A PROLONGED PERIOD ON THE RATE OF ENERGY EXPENDITURE

INTRODUCTION AND PURPOSE

This is another in the series of theses conducted in the Metabolic Laboratory of Purdue University and employing the use of the Sanborn EIS Metabolism Tester. During the years since 1907 there have been many experiments conducted involving the measurement of energy expenditure by use of metabolic studies of various tasks, but none of these studies have been conducted for a prolonged continuous period. This thesis is undertaken to determine just what effect a prolonged period of performance of a simple task will have on energy expenditure. A bi-product of the research will be a statement of the length of time, up to the time limit used, that each of the simple tasks employed can be accomplished before a significant change in energy expenditure is noted.

DETERMINATION OF THE EFFECT OF IRRADIATION & TEMPERATURE ON THE
A PROPOSED METHOD OF THE RATE OF ENERGY EXPENDITURE

INTRODUCTION AND SUMMARY

This is reported in the series of papers published in
the Metabolic Laboratory of Johns Hopkins University and employing
the use of the Sarnoff and Sarnoff's method. During the
years since 1907 there have been many experiments conducted
involving the measurement of energy expenditure by use of
metabolic studies of various tasks, but none of these studies
have been conducted for a prolonged continuous period. This
thesis is undertaken to determine just what effect a pro-
longed period of performance of a simple task will have on
energy expenditure. A bi-product of the research will be a
statement of the length of time, up to the time limit used,
that each of the simple tasks employed can be accomplished
before a significant change in energy expenditure is noted.

PROCEDURE

Due to the length of time required to test each student and the number of theses being conducted on the metabolic equipment at the time of this study, it was decided to limit the testing to nine male students. These students were selected at random from motion and time study classes at Purdue University. No attempt was made to select students of the same age, height or weight, as can be seen in Table 1.

The limitations explained in the previous paragraph are also the reasons that the time of testing was not limited to the early morning period. To eliminate the possibility of the order of tests having an effect on the results, the tests were conducted in accordance with Table 2. Only one test per student was conducted on any particular day.

Prior to each test the student to be tested was allowed to become familiar with the procedure in performing the task. On the day a particular test was to be performed the student came to the laboratory and spent the first thirty minutes resting in a reclined position. Just prior to the end of the thirty minute rest period the student got into position for the test to be performed; the nose clamp was adjusted and the mouthpiece shield inserted. With the beginning of the test as "zero" time, the following schedule was adhered to for all the tests:

One to two lengths of time required to test each student and the number of cases being conducted on the available equipment at the time of this study, it was decided to limit the testing to nine male students. These students were selected at random from sections and were given classes at Prince University. No attempt was made to select students of the same age, height or weight, as can be seen in Table I. The limitations explained in the previous paragraph are also the reason that the time of testing was not listed as the only scoring period. To eliminate the possibility of the order of cases having an effect on the results, the tests were conducted in accordance with Table II. Only one test per student was conducted on any particular day.

It is to be noted that the attempt to be tested was allowed to be tested further with the procedure in evaluating the test. On the day a particular test was to be performed the student came to the laboratory and spent the first thirty minutes resting in a reclined position. Just prior to the end of the thirty minute rest period the student was into position for the test to be performed; the room light was adjusted and the microphone cable lowered. With the beginning of the test an "easy" time, one following schedule was allowed to for all the tests:

TABLE 1

<u>STUDENT</u>	<u>AGE</u>	<u>HEIGHT</u>	<u>WEIGHT</u>
1	32	5'-9"	161
2	29	5'-11"	133
3	29	5'-6"	162
4	25	6'-0"	190
5	24	5'-11"	176
6	21	5'-7"	154
7	24	6'-2"	200
8	29	5'-9"	142
9	21	6'-0"	155

TABLE I

PERIOD	THICKNESS	AREA	THICKNESS
100	0.10	10	1
100	0.11	10	2
100	0.12	10	3
100	0.13	10	4
100	0.14	10	5
100	0.15	10	6
100	0.16	10	7
100	0.17	10	8
100	0.18	10	9
100	0.19	10	10

Time	Elapsed Time	Notes
00-01	1 minute	Speakers received main air while performing test.
00-02	2 minutes	Various readings of the system, the available equipment was turned on and a pump for the tank.
00-03	3 minutes	Time as 00-02 minutes.
00-04	4 minutes	Time as 00-03 minutes.
00-05	5 minutes	Time as 00-04 minutes.
00-06	6 minutes	Time as 00-05 minutes.

TABLE 2

SEQUENCE OF TESTS

<u>STUDENT</u>		<u>1st TEST</u>	<u>2nd TEST</u>	<u>3rd TEST</u>
1	1 minute	1	2	3
2	1 minute	3	1	2
3	1 minute	1	3	2
4	1 minute	3	2	1
5	1 minute	2	1	3
6	1 minute	2	3	1
7	1 minute	1	2	3
8	1 minute	3	2	1
9	1 minute	2	1	3

8 Test 1 consisted of a series of tests, by the use of which the student was to determine the relative positions of the various parts of a mechanism. This was done by the use of a standard piece of equipment with a single large stop film.¹ It is the same test used by E. A. Davis

¹ Davis, E. A., *Methods and Apparatus for the Study of the Human Mind*, New York, 1900, p. 200.
² See E. A. Davis in *Psychological Review*, Vol. 1, No. 1, 1900, p. 1.

TABLE 2

REVENUE OF TEXAS

1911	1912	1913	1914
1	1	1	1
2	1	2	1
3	2	1	2
4	3	2	3
5	4	3	4
6	5	4	5
7	6	5	6
8	7	6	7
9	8	7	8
10	9	8	9

Time	Elapsed Time	Action
00-01	1 minute	Operator breathed room air while performing task.
01-05	4 minutes	Without knowledge of the operator, the metabolic equipment was turned on and a record run was made.
05-10	5 minutes	Same as 00-01 minutes.
10-14	4 minutes	Same as 01-05 minutes.
14-20	6 minutes	Same as 00-01 minutes.
20-24	4 minutes	Same as 01-05 minutes.
24-30	6 minutes	Same as 00-01 minutes.
30-34	4 minutes	Same as 01-05 minutes.
34-40	6 minutes	Same as 00-01 minutes.
40-44	4 minutes	Same as 01-05 minutes.
44-50	6 minutes	Same as 00-01 minutes.
50-54	4 minutes	Same as 01-05 minutes.
54-60	6 minutes	Same as 00-01 minutes.
60-64	4 minutes	Same as 01-05 minutes.

Test 1 consisted of a seventeen inch transfer, by the right hand, of small steel balls at a tempo of 96 one way beats per minute of a metronome. This task was rated at 110 percent of standard pace by comparison with a multi-image step film.¹ It is the exact task used by J. A. Marks

¹Mundel, M. E., Motion and Time Study Principles and Practice, Prentice-Hall Inc., New York, 1950, p. 324.

and W. D. Surface in their work.² See Figure 1.

Time	Elapsed Time	Action
00-01	1 minute	Operator prepared from air while performing tests.
01-05	4 minutes	Without knowledge of the operator, the catalytic equipment was turned on and a second run was made.
05-10	5 minutes	Same as 00-01 minutes.
10-14	4 minutes	Same as 01-05 minutes.
14-20	6 minutes	Same as 00-01 minutes.
20-24	4 minutes	Same as 01-05 minutes.
24-30	6 minutes	Same as 00-01 minutes.
30-34	4 minutes	Same as 01-05 minutes.
34-40	6 minutes	Same as 00-01 minutes.
40-44	4 minutes	Same as 01-05 minutes.
44-50	6 minutes	Same as 00-01 minutes.
50-54	4 minutes	Same as 01-05 minutes.
54-60	6 minutes	Same as 00-01 minutes.
60-70	10 minutes	Same as 01-05 minutes.

Test 1 consisted of a seventeen hour run, by the time that, of small steel balls at a speed of 750 rpm. Tests per minute of a revolution. This test was rated at 110 percent of standard power by comparison with a single image over time. It is the exact test used by J. A. Harris

W. A. Harris and J. A. Harris, *Journal of Applied Physics*, 1950, p. 244.
 Friction, Friction-Mill Inc., New York, 1950, p. 244.
 and W. A. Harris in their work, see Figure 1.

Wheeler, J. A., The Effect of Position and Temperature on Circulation of Blood, University of Indiana, Indiana University, Purdue University, Lafayette, Indiana, 1911.

Wheeler, J. A., The Effect of Position on the Metabolic Rate of Man, University of Indiana, Indiana University, Purdue University, Lafayette, Indiana, 1911.

Test 1 consisted of a **FIGURE 1** live limb within the reach

and between points
not less than 100
100 percent of the
of the limb used in

Wheeler, J. A., in 1911
University of Indiana,
Lafayette, Indiana.

Test 2 consisted
of the limb used in
100 percent of the
100 percent of the

age of 100 and
last was used as
stable in the
See Figure 1.

copy of the
University of
Lafayette, Indiana.

with the limb
of 100 and the
the point of



POSITIONS FOR TEST 1

1. 100000



1. 100000

²Marks, J. A., The Effect of Praise and Reprimand on Workers' Energy Expenditure, Master of Science Thesis, Purdue University, Lafayette, Indiana, 1951.

Surface, W. D., The Effect of Music on the Metabolic Rate of Workers, Master of Science Thesis, Purdue University, Lafayette, Indiana, 1951.

Test 2 consisted of a twenty-five inch motion for each arm between points on the table edge at a tempo of 160 one way beats per minute of a metronome. This task was rated at 135 percent of standard pace. This task is similiar to one of the tasks used by S. Tilles in his work.³ See Figure 2.

³Tilles, S., An Investigation of the Suitability of the Sanborn EIS Metabolism Tester to Basic Time Study Experimentation, Master of Science Thesis, Purdue University, Lafayette, Indiana, 1949.

Test 3 consisted of pedaling a bicycle, with the chain to the back wheel disconnected, at a tempo of 138 one way beats per minute of a metronome. This task was rated at 120 percent of standard pace. See Figure 3.



FIGURE 3

James, J. A., The Effect of Stress and Repression on Memory,
Psychological Monographs, Number 10, University of Chicago Press,
Chicago, 1931.

Wirtz, W. D., The Effect of Stress on the Memory of
of Memory, Number 10, University of Chicago Press,
Chicago, 1931.

Test 1 consisted of a twenty-five inch wheel with two
and between points on the inside edge at a length of 100 and
any points per minute of a revolution. This test was used at
100 percent of standard pace. This test is similar to one
of the tests used by S. Wirtz in his work. See Figure 2.

Wirtz, W. D., An Investigation of the Effect of the
University of Chicago Press, Chicago, 1931.

Test 2 consisted of pedaling a bicycle, with the wheels
to the back wheel disconnected, at a tempo of 100 and any
points per minute of a revolution. This test was used at
100 percent of standard pace. See Figure 2.

FIGURE 2



POSITIONS FOR TEST 2

A HOUSE



A TIME OUT MOVING

POSITIONS FOR TEST 3

PLATE 1



PLATE 1

RESULTS AND CONCLUSION

The method of least squares was used to calculate the slopes of the charts obtained from the metabolic tester. Tables 3 to 11 contain the results for the various students. Tables 12 to 17 present the information for all students for each test, and also include the values of "t" obtained by the Student "t" technique of statistical analysis. Appendix A shows an example of how these "t" values were calculated. The Student "t" technique indicated that for each of the three tests there was no significant difference, at the five per-cent level, between the base reading for the test and the readings taken at any other time during the test. In the analysis, all the values obtained for student 8 were omitted as that student was a controlled breather and his charts did not have sufficient points to give a consistent value. The information for student 7, test 2, was also eliminated due to the fact that the nose clamp became loose during the base run and caused the obviously false readings.

The conclusion arrived at is that for a relatively simple task similiar to those used in this thesis the energy expenditure rises rapidly during the first minute of performing the task and does not change significantly for at least sixty-four minutes. Since all the previous experiments in the Purdue Metabolic Laboratory have been based on the fact

RESULTS AND CONCLUSIONS

The method of least squares was used to calculate the slopes of the charts obtained from the metabolic water. Tables 2 to 11 contain the results for the various students. Table 12 to 14 present the information for all students for each test, and also include the values of "t" obtained by the Student "t" technique of statistical analysis. Appendix A shows an example of how these "t" values were calculated. The Student "t" technique indicated that for each of the three tests there was no significant difference, at the five per cent level, between the same readings for the test and the readings taken at any other time during the test. In the analysis, all the values obtained for Student 2 were omitted as that student was a controlled person and his charts did not have sufficient points to give a consistent value. The information for Student 7, Test 2, was also eliminated due to the fact that the nose clamp became loose during the test and caused the obviously false readings.

The conclusion arrived at is that for a relatively simple test similar to those used in this thesis the energy expenditure rises rapidly during the first minute of exerting the task and does not change significantly for at least sixty-four minutes. Since all the previous experiments in the Marine Metabolic Laboratory have been based on the fact

that the energy expenditure did remain constant, this thesis
helps to verify that fact. It also points out that rest
periods need not be used once the work has commenced if all
readings can be obtained in a one hour period.

TABLE 3

STUDENT NUMBER 1

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	20 C	.430	100
	10-14	23 C	.434	101
	20-24	24 C	.450	105
	30-34	24 C	.459	107
	40-44	25 C	.549	128
	50-54	26 C	.474	110
	60-64	26 C	.460	107
2	01-05	26 C	.602	100
	10-14	27 C	.612	102
	20-24	27 C	.600	100
	30-34	28 C	.622	103
	40-44	28 C	.596	99
	50-54	27 C	.637	106
	60-64	28 C	.621	103
3	01-05	23 C	.734	100
	10-14	24 C	.736	100
	20-24	24 C	.660	90
	30-34	25 C	.628	86
	40-44	25 C	.622	85
	50-54	26 C	.668	91
	60-64	27 C	.674	92

	TEST 1	TEST 2	TEST 3
DATE	3/13/51	4/4/51	4/12/51
START TIME	2:38 P.M.	3:53 P.M.	4:35 P.M.
BAROMETER	28.90"	29.25"	28.70"

TABLE 2

STUDENT NUMBER 1				TEST			
TIME (MIN)	SCORE	TIME	SCORE	TIME (MIN)	SCORE		
01-03	20 C	01-03	20 C	01-03	20 C		
10-14	22 C	10-14	22 C	10-14	22 C		
20-24	24 C	20-24	24 C	20-24	24 C		
30-34	24 C	30-34	24 C	30-34	24 C		
40-44	25 C	40-44	25 C	40-44	25 C		
50-54	25 C	50-54	25 C	50-54	25 C		
60-64	25 C	60-64	25 C	60-64	25 C		
01-03	25 C	01-03	25 C	01-03	25 C		
10-14	27 C	10-14	27 C	10-14	27 C		
20-24	27 C	20-24	27 C	20-24	27 C		
30-34	28 C	30-34	28 C	30-34	28 C		
40-44	28 C	40-44	28 C	40-44	28 C		
50-54	27 C	50-54	27 C	50-54	27 C		
60-64	28 C	60-64	28 C	60-64	28 C		
01-03	28 C	01-03	28 C	01-03	28 C		
10-14	24 C	10-14	24 C	10-14	24 C		
20-24	24 C	20-24	24 C	20-24	24 C		
30-34	25 C	30-34	25 C	30-34	25 C		
40-44	25 C	40-44	25 C	40-44	25 C		
50-54	25 C	50-54	25 C	50-54	25 C		
60-64	27 C	60-64	27 C	60-64	27 C		
TEST 1				TEST 2			
DATE	START TIME	END TIME	SCORE	DATE	START TIME	END TIME	SCORE
2/12/21	8:00 P.M.	8:00 P.M.	28.00	2/12/21	8:00 P.M.	8:00 P.M.	28.00

TABLE 4

STUDENT NUMBER 2

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	27 C	.458	100
	10-14	28 C	.475	104
	20-24	29 C	.451	98
	30-34	29 C	.492	107
	40-44	30 C	.432	94
	50-54	31 C	.442	97
	60-64	31 C	.450	98
2	01-05	26 C	.634	100
	10-14	27 C	.619	98
	20-24	27 C	.589	93
	30-34	27 C	.580	91
	40-44	27 C	.590	93
	50-54	27 C	.625	99
	60-64	27 C	.535	84
3	01-05	26 C	.531	100
	10-14	26 C	.619	117
	20-24	27 C	.609	115
	30-34	27 C	.584	110
	40-44	27 C	.549	103
	50-54	28 C	.562	106
	60-64	28 C	.528	99

TEST 1

TEST 2

TEST 3

DATE 3/23/51
 START TIME 4:20 P.M.
 BAROMETER 29.37"

4/4/51
 9:19 P.M.
 29.29"

3/19/51
 4:00 P.M.
 29.37"

TABLE 2

TEST	TIME (MIN)	TEMP.	GROUP	W OF 01-02 MIN.
1	01-02	27 C	555.	100
	10-14	28 C	572.	100
	20-24	29 C	581.	100
	30-34	29 C	584.	100
	40-44	30 C	585.	100
	50-54	31 C	586.	100
	60-64	31 C	580.	100
2	01-02	28 C	584.	100
	10-14	29 C	585.	100
	20-24	29 C	586.	100
	30-34	29 C	587.	100
	40-44	29 C	588.	100
	50-54	29 C	589.	100
	60-64	29 C	589.	100
3	01-02	28 C	581.	100
	10-14	28 C	581.	100
	20-24	27 C	583.	100
	30-34	27 C	584.	100
	40-44	27 C	584.	100
	50-54	28 C	585.	100
	60-64	28 C	585.	100
DATE	8/23/51	8/23/51	8/23/51	8/23/51
START TIME	4:00 P.M.	4:00 P.M.	4:00 P.M.	4:00 P.M.
END TIME	22:55	22:55	22:55	22:55
TEST 1	TEST 2	TEST 3	TEST 4	TEST 5

TABLE 5

STUDENT NUMBER 3

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	26 C	.423	100
	10-14	27 C	.438	104
	20-24	28 C	.409	97
	30-34	28 C	.392	93
	40-44	28 C	.421	100
	50-54	28 C	.414	98
	60-64	29 C	.425	100
2	01-05	22 C	.575	100
	10-14	23 C	.519	90
	20-24	25 C	.492	86
	30-34	25 C	.528	92
	40-44	26 C	.496	86
	50-54	26 C	.551	96
	60-64	26 C	.475	83
3	01-05	25 C	.718	100
	10-14	25 C	.703	98
	20-24	27 C	.669	93
	30-34	26 C	.689	96
	40-44	28 C	.689	96
	50-54	29 C	.767	107
	60-64	29 C	.839	117

	TEST 1	TEST 2	TEST 3
DATE	4/5/51	4/27/51	4/23/51
START TIME	2:45 P.M.	12:33 P.M.	12:00 P.M.
BAROMETER	29.33"	29.47"	29.62"

5. 1990年12月10日

TEST	DATE/TIME	TEST	DATE/TIME	TEST	DATE/TIME
1	10-10	2	10-10	3	10-10
101	10-10	102	10-10	103	10-10
104	10-10	105	10-10	106	10-10
107	10-10	108	10-10	109	10-10
110	10-10	111	10-10	112	10-10
113	10-10	114	10-10	115	10-10
116	10-10	117	10-10	118	10-10
119	10-10	120	10-10	121	10-10
122	10-10	123	10-10	124	10-10
125	10-10	126	10-10	127	10-10
128	10-10	129	10-10	130	10-10
131	10-10	132	10-10	133	10-10
134	10-10	135	10-10	136	10-10
137	10-10	138	10-10	139	10-10
140	10-10	141	10-10	142	10-10
143	10-10	144	10-10	145	10-10
146	10-10	147	10-10	148	10-10
149	10-10	150	10-10	151	10-10
152	10-10	153	10-10	154	10-10
155	10-10	156	10-10	157	10-10
158	10-10	159	10-10	160	10-10
161	10-10	162	10-10	163	10-10
164	10-10	165	10-10	166	10-10
167	10-10	168	10-10	169	10-10
170	10-10	171	10-10	172	10-10
173	10-10	174	10-10	175	10-10
176	10-10	177	10-10	178	10-10
179	10-10	180	10-10	181	10-10
182	10-10	183	10-10	184	10-10
185	10-10	186	10-10	187	10-10
188	10-10	189	10-10	190	10-10
191	10-10	192	10-10	193	10-10
194	10-10	195	10-10	196	10-10
197	10-10	198	10-10	199	10-10
200	10-10	201	10-10	202	10-10
203	10-10	204	10-10	205	10-10
206	10-10	207	10-10	208	10-10
209	10-10	210	10-10	211	10-10
212	10-10	213	10-10	214	10-10
215	10-10	216	10-10	217	10-10
218	10-10	219	10-10	220	10-10
221	10-10	222	10-10	223	10-10
224	10-10	225	10-10	226	10-10
227	10-10	228	10-10	229	10-10
230	10-10	231	10-10	232	10-10
233	10-10	234	10-10	235	10-10
236	10-10	237	10-10	238	10-10
239	10-10	240	10-10	241	10-10
242	10-10	243	10-10	244	10-10
245	10-10	246	10-10	247	10-10
248	10-10	249	10-10	250	10-10
251	10-10	252	10-10	253	10-10
254	10-10	255	10-10	256	10-10
257	10-10	258	10-10	259	10-10
260	10-10	261	10-10	262	10-10
263	10-10	264	10-10	265	10-10
266	10-10	267	10-10	268	10-10
269	10-10	270	10-10	271	10-10
272	10-10	273	10-10	274	10-10
275	10-10	276	10-10	277	10-10
278	10-10	279	10-10	280	10-10
281	10-10	282	10-10	283	10-10
284	10-10	285	10-10	286	10-10
287	10-10	288	10-10	289	10-10
290	10-10	291	10-10	292	10-10
293	10-10	294	10-10	295	10-10
296	10-10	297	10-10	298	10-10
299	10-10	300	10-10	301	10-10
302	10-10	303	10-10	304	10-10
305	10-10	306	10-10	307	10-10
308	10-10	309	10-10	310	10-10
311	10-10	312	10-10	313	10-10
314	10-10	315	10-10	316	10-10
317	10-10	318	10-10	319	10-10
320	10-10	321	10-10	322	10-10
323	10-10	324	10-10	325	10-10
326	10-10	327	10-10	328	10-10
329	10-10	330	10-10	331	10-10
332	10-10	333	10-10	334	10-10
335	10-10	336	10-10	337	10-10
338	10-10	339	10-10	340	10-10
341	10-10	342	10-10	343	10-10
344	10-10	345	10-10	346	10-10
347	10-10	348	10-10	349	10-10
350	10-10	351	10-10	352	10-10
353	10-10	354	10-10	355	10-10
356	10-10	357	10-10	358	10-10
359	10-10	360	10-10	361	10-10
362	10-10	363	10-10	364	10-10
365	10-10	366	10-10	367	10-10
368	10-10	369	10-10	370	10-10
371	10-10	372	10-10	373	10-10
374	10-10	375	10-10	376	10-10
377	10-10	378	10-10	379	10-10
380	10-10	381	10-10	382	10-10
383	10-10	384	10-10	385	10-10
386	10-10	387	10-10	388	10-10
389	10-10	390	10-10	391	10-10
392	10-10	393	10-10	394	10-10
395	10-10	396	10-10	397	10-10
398	10-10	399	10-10	400	10-10

TABLE 6

STUDENT NUMBER 4

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	29 C	.439	100
	10-14	30 C	.502	114
	20-24	30 C	.449	102
	30-34	30 C	.446	102
	40-44	31 C	.458	104
	50-54	31 C	.402	92
	60-64	32 C	.426	97
2	01-05	30 C	.666	100
	10-14	30 C	.735	110
	20-24	29 C	.638	96
	30-34	29 C	.625	94
	40-44	30 C	.600	90
	50-54	29 C	.629	94
	60-64	31 C	.640	96
3	01-05	22 C	.618	100
	10-14	22 C	.810	131
	20-24	24 C	.708	115
	30-34	25 C	.688	111
	40-44	25 C	.687	111
	50-54	25 C	.747	121
	60-64	24 C	.787	127

	TEST 1	TEST 2	TEST 3
DATE	4/27/51	4/25/51	4/9/51
START TIME	4:00 P.M.	4:07 P.M.	10:45 A.M.
BAROMETER	29.49"	29.24"	28.96"

TABLE 7

STUDENT NUMBER 5

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	24 C	.482	100
	10-14	25 C	.521	108
	20-24	25 C	.484	100
	30-34	26 C	.489	101
	40-44	27 C	.539	112
	50-54	27 C	.471	98
	60-64	27 C	.443	92
2	01-05	22 C	.709	100
	10-14	25 C	.682	96
	20-24	25 C	.639	90
	30-34	26 C	.633	89
	40-44	26 C	.584	82
	50-54	27 C	.602	85
	60-64	27 C	.677	95
3	01-05	22 C	.651	100
	10-14	24 C	.756	116
	20-24	24 C	.690	106
	30-34	23 C	.689	106
	40-44	24 C	.656	101
	50-54	24 C	.599	92
	60-64	24 C	.625	96

TEST 1

TEST 2

TEST 3

DATE
START TIME
BAROMETER

4/12/51
12:50 P.M.
28.70"

4/9/51
1:00 P.M.
28.94"

4/19/51
12:48 P.M.
29.36"

9 JULY

[Illegible text]

DATE	TIME	LOCATION	WIND	TEMP	SEA	REMARKS
10-10-1961	0800	10-10-1961	0 42	23-10		1
1001	0801	1001	0 42	21-01		
1001	0801	1001	0 42	21-03		
1001	0801	1001	0 42	20-08		
1001	0801	1001	0 42	24-04		
1001	0801	1001	0 42	20-05		
1001	0801	1001	0 42	20-03		
1001	0801	1001	0 42	20-10		2
1001	0801	1001	0 42	21-01		
1001	0801	1001	0 42	20-02		
1001	0801	1001	0 42	20-03		
1001	0801	1001	0 42	20-04		
1001	0801	1001	0 42	20-05		
1001	0801	1001	0 42	20-04		
1001	0801	1001	0 42	20-05		3
1001	0801	1001	0 42	20-01		
1001	0801	1001	0 42	20-02		
1001	0801	1001	0 42	20-03		
1001	0801	1001	0 42	20-04		
1001	0801	1001	0 42	20-05		
1001	0801	1001	0 42	20-03		
1001	0801	1001	0 42	20-04		

DATE	TIME	TEST
11/18/51	1:00 P.M.	TEST 1
11/18/51	1:00 P.M.	TEST 2
11/18/51	1:00 P.M.	TEST 3

TABLE 8

STUDENT NUMBER 6

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	25 C	.470	100
	10-14	25 C	.435	93
	20-24	26 C	.458	97
	30-34	26 C	.449	96
	40-44	27 C	.450	96
	50-54	27 C	.424	90
	60-64	28 C	.429	91
2	01-05	27 C	.727	100
	10-14	27 C	.766	105
	20-24	28 C	.700	96
	30-34	27 C	.703	97
	40-44	27 C	.600	82
	50-54	28 C	.636	88
	60-64	28 C	.617	85
3	01-05	26 C	.823	100
	10-14	27 C	.833	101
	20-24	28 C	.849	103
	30-34	28 C	.841	102
	40-44	29 C	.916	111
	50-54	29 C	.925	112
	60-64	29 C	1.006	122

TEST 1

TEST 2

TEST 3

DATE

4/20/51

4/13/51

4/14/51

START TIME

9:48 A.M.

4:00 P.M.

2:40 P.M.

BAROMETER

29.62"

28.74"

28.92"

TABLE 2

STATIONARY RECORDS

TEST	TIME (MIN)	TEMP.	WIND	WIND DIR
1	01-00	55.0	4.5	100
	10-10	55.0	4.5	100
	20-20	55.0	4.5	100
	30-30	55.0	4.5	100
	40-40	55.0	4.5	100
	50-50	55.0	4.5	100
	60-60	55.0	4.5	100
	70-70	55.0	4.5	100
2	01-00	55.0	4.5	100
	10-10	55.0	4.5	100
	20-20	55.0	4.5	100
	30-30	55.0	4.5	100
	40-40	55.0	4.5	100
	50-50	55.0	4.5	100
	60-60	55.0	4.5	100
	70-70	55.0	4.5	100
3	01-00	55.0	4.5	100
	10-10	55.0	4.5	100
	20-20	55.0	4.5	100
	30-30	55.0	4.5	100
	40-40	55.0	4.5	100
	50-50	55.0	4.5	100
	60-60	55.0	4.5	100
	70-70	55.0	4.5	100
4	01-00	55.0	4.5	100
	10-10	55.0	4.5	100
	20-20	55.0	4.5	100
	30-30	55.0	4.5	100
	40-40	55.0	4.5	100
	50-50	55.0	4.5	100
	60-60	55.0	4.5	100
	70-70	55.0	4.5	100

DATE
STATION
REMARKS

TEST 1
4:00 P.M.
5:00 P.M.

TEST 2
4:00 P.M.
5:00 P.M.

TEST 3
4:00 P.M.
5:00 P.M.

TABLE 9

STUDENT NUMBER 7

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	25 C	.541	100
	10-14	25 C	.498	92
	20-24	26 C	.481	89
	30-34	26 C	.479	88
	40-44	27 C	.485	90
	50-54	27 C	.495	92
	60-64	27 C	.453	84
2	01-05	25 C	.498	100
	10-14	26 C	.711	143
	20-24	27 C	.701	142
	30-34	28 C	.662	133
	40-44	28 C	.784	157
	50-54	28 C	.625	126
	60-64	28 C	.648	130
3	01-05	27 C	.905	100
	10-14	28 C	.642	71
	20-24	28 C	.840	93
	30-34	28 C	.814	90
	40-44	29 C	.789	87
	50-54	29 C	.821	91
	60-64	29 C	.788	87

	TEST 1	TEST 2	TEST 3
DATE	4/16/51	4/18/51	4/20/51
START TIME	2:40 P.M.	2:35 P.M.	2:40 P.M.
BAROMETER	29.29"	28.98"	29.54"

TABLE 3

STATION NUMBER 7				
TIME	TIME (MIN)	TEMP.	WIND	WIND DIR
1	01-00	55	0	100
	10-10	52	0	100
	20-20	50	0	100
	30-30	48	0	100
	40-40	45	0	100
	50-50	43	0	100
	60-60	40	0	100
2	01-00	55	0	100
	10-10	52	0	100
	20-20	50	0	100
	30-30	48	0	100
	40-40	45	0	100
	50-50	43	0	100
	60-60	40	0	100
3	01-00	55	0	100
	10-10	52	0	100
	20-20	50	0	100
	30-30	48	0	100
	40-40	45	0	100
	50-50	43	0	100
	60-60	40	0	100

DATE	TIME	STATION	WIND	WIND DIR
8/19/51	8:40 P.M.	27.50"	0	100
8/19/51	8:40 P.M.	27.50"	0	100
8/19/51	8:40 P.M.	27.50"	0	100

TABLE 10

STUDENT NUMBER 8

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	24 C	.454	100
	10-14	25 C	.389	86
	20-24	25 C	.486	107
	30-34	26 C	.380	84
	40-44	26 C	.372	82
	50-54	27 C	.366	81
	60-64	27 C	.398	88
2	01-05	27 C	.490	100
	10-14	28 C	.422	86
	20-24	28 C	.559	114
	30-34	28 C	.685	140
	40-44	28 C	.508	104
	50-54	28 C	.742	151
	60-64	28 C	.686	140
3	01-05	28 C	.567	100
	10-14	29 C	.595	105
	20-24	28 C	.443	78
	30-34	27 C	.611	108
	40-44	27 C	.501	88
	50-54	27 C	.614	108
	60-64	27 C	.497	88

	TEST 1	TEST 2	TEST 3
DATE	4/19/51	4/18/51	4/16/51
START TIME	4:18 P.M.	4:30 P.M.	4:27 P.M.
BAROMETER	29.38"	29.00"	29.32"

OF 1907

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[illegible]

TABLE 11

STUDENT NUMBER 9

<u>TEST</u>	<u>TIME(MIN)</u>	<u>TEMP.</u>	<u>SLOPE</u>	<u>% OF 01-05 MIN.</u>
1	01-05	27 C	.510	100
	10-14	27 C	.481	94
	20-24	27 C	.438	86
	30-34	29 C	.500	98
	40-44	29 C	.388	76
	50-54	29 C	.466	91
	60-64	30 C	.456	89
2	01-05	27 C	.555	100
	10-14	27 C	.624	112
	20-24	27 C	.609	110
	30-34	27 C	.623	112
	40-44	28 C	.625	113
	50-54	28 C	.601	108
	60-64	28 C	.644	116
3	01-05	31 C	.704	100
	10-14	32 C	.731	104
	20-24	32 C	.695	99
	30-34	33 C	.739	105
	40-44	33 C	.698	99
	50-54	34 C	.699	99
	60-64	34 C	.664	94

	TEST 1	TEST 2	TEST 3
DATE	4/24/51	4/23/51	5/21/51
START TIME	12:40 P.M.	2:36 P.M.	2:30 P.M.
BAROMETER	29.43"	29.60"	29.18"

TABLE II

STATION NUMBER 1

TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE
1	01-00	01.0	01.0	01-00	01.0	01-00	01.0
	01-01	01.1	01.1	01-01	01.1	01-01	01.1
	01-02	01.2	01.2	01-02	01.2	01-02	01.2
	01-03	01.3	01.3	01-03	01.3	01-03	01.3
	01-04	01.4	01.4	01-04	01.4	01-04	01.4
	01-05	01.5	01.5	01-05	01.5	01-05	01.5
	01-06	01.6	01.6	01-06	01.6	01-06	01.6
	01-07	01.7	01.7	01-07	01.7	01-07	01.7
	01-08	01.8	01.8	01-08	01.8	01-08	01.8
	01-09	01.9	01.9	01-09	01.9	01-09	01.9
	01-10	02.0	02.0	01-10	02.0	01-10	02.0
	01-11	02.1	02.1	01-11	02.1	01-11	02.1
	01-12	02.2	02.2	01-12	02.2	01-12	02.2
	01-13	02.3	02.3	01-13	02.3	01-13	02.3
	01-14	02.4	02.4	01-14	02.4	01-14	02.4
	01-15	02.5	02.5	01-15	02.5	01-15	02.5
	01-16	02.6	02.6	01-16	02.6	01-16	02.6
	01-17	02.7	02.7	01-17	02.7	01-17	02.7
	01-18	02.8	02.8	01-18	02.8	01-18	02.8
	01-19	02.9	02.9	01-19	02.9	01-19	02.9
	01-20	03.0	03.0	01-20	03.0	01-20	03.0
	01-21	03.1	03.1	01-21	03.1	01-21	03.1
	01-22	03.2	03.2	01-22	03.2	01-22	03.2
	01-23	03.3	03.3	01-23	03.3	01-23	03.3
	01-24	03.4	03.4	01-24	03.4	01-24	03.4
	01-25	03.5	03.5	01-25	03.5	01-25	03.5
	01-26	03.6	03.6	01-26	03.6	01-26	03.6
	01-27	03.7	03.7	01-27	03.7	01-27	03.7
	01-28	03.8	03.8	01-28	03.8	01-28	03.8
	01-29	03.9	03.9	01-29	03.9	01-29	03.9
	01-30	04.0	04.0	01-30	04.0	01-30	04.0
	01-31	04.1	04.1	01-31	04.1	01-31	04.1
	02-01	04.2	04.2	02-01	04.2	02-01	04.2
	02-02	04.3	04.3	02-02	04.3	02-02	04.3
	02-03	04.4	04.4	02-03	04.4	02-03	04.4
	02-04	04.5	04.5	02-04	04.5	02-04	04.5
	02-05	04.6	04.6	02-05	04.6	02-05	04.6
	02-06	04.7	04.7	02-06	04.7	02-06	04.7
	02-07	04.8	04.8	02-07	04.8	02-07	04.8
	02-08	04.9	04.9	02-08	04.9	02-08	04.9
	02-09	05.0	05.0	02-09	05.0	02-09	05.0
	02-10	05.1	05.1	02-10	05.1	02-10	05.1
	02-11	05.2	05.2	02-11	05.2	02-11	05.2
	02-12	05.3	05.3	02-12	05.3	02-12	05.3
	02-13	05.4	05.4	02-13	05.4	02-13	05.4
	02-14	05.5	05.5	02-14	05.5	02-14	05.5
	02-15	05.6	05.6	02-15	05.6	02-15	05.6
	02-16	05.7	05.7	02-16	05.7	02-16	05.7
	02-17	05.8	05.8	02-17	05.8	02-17	05.8
	02-18	05.9	05.9	02-18	05.9	02-18	05.9
	02-19	06.0	06.0	02-19	06.0	02-19	06.0
	02-20	06.1	06.1	02-20	06.1	02-20	06.1
	02-21	06.2	06.2	02-21	06.2	02-21	06.2
	02-22	06.3	06.3	02-22	06.3	02-22	06.3
	02-23	06.4	06.4	02-23	06.4	02-23	06.4
	02-24	06.5	06.5	02-24	06.5	02-24	06.5
	02-25	06.6	06.6	02-25	06.6	02-25	06.6
	02-26	06.7	06.7	02-26	06.7	02-26	06.7
	02-27	06.8	06.8	02-27	06.8	02-27	06.8
	02-28	06.9	06.9	02-28	06.9	02-28	06.9
	02-29	07.0	07.0	02-29	07.0	02-29	07.0
	02-30	07.1	07.1	02-30	07.1	02-30	07.1
	03-01	07.2	07.2	03-01	07.2	03-01	07.2
	03-02	07.3	07.3	03-02	07.3	03-02	07.3
	03-03	07.4	07.4	03-03	07.4	03-03	07.4
	03-04	07.5	07.5	03-04	07.5	03-04	07.5
	03-05	07.6	07.6	03-05	07.6	03-05	07.6
	03-06	07.7	07.7	03-06	07.7	03-06	07.7
	03-07	07.8	07.8	03-07	07.8	03-07	07.8
	03-08	07.9	07.9	03-08	07.9	03-08	07.9
	03-09	08.0	08.0	03-09	08.0	03-09	08.0
	03-10	08.1	08.1	03-10	08.1	03-10	08.1
	03-11	08.2	08.2	03-11	08.2	03-11	08.2
	03-12	08.3	08.3	03-12	08.3	03-12	08.3
	03-13	08.4	08.4	03-13	08.4	03-13	08.4
	03-14	08.5	08.5	03-14	08.5	03-14	08.5
	03-15	08.6	08.6	03-15	08.6	03-15	08.6
	03-16	08.7	08.7	03-16	08.7	03-16	08.7
	03-17	08.8	08.8	03-17	08.8	03-17	08.8
	03-18	08.9	08.9	03-18	08.9	03-18	08.9
	03-19	09.0	09.0	03-19	09.0	03-19	09.0
	03-20	09.1	09.1	03-20	09.1	03-20	09.1
	03-21	09.2	09.2	03-21	09.2	03-21	09.2
	03-22	09.3	09.3	03-22	09.3	03-22	09.3
	03-23	09.4	09.4	03-23	09.4	03-23	09.4
	03-24	09.5	09.5	03-24	09.5	03-24	09.5
	03-25	09.6	09.6	03-25	09.6	03-25	09.6
	03-26	09.7	09.7	03-26	09.7	03-26	09.7
	03-27	09.8	09.8	03-27	09.8	03-27	09.8
	03-28	09.9	09.9	03-28	09.9	03-28	09.9
	03-29	10.0	10.0	03-29	10.0	03-29	10.0
	03-30	10.1	10.1	03-30	10.1	03-30	10.1
	03-31	10.2	10.2	03-31	10.2	03-31	10.2
	04-01	10.3	10.3	04-01	10.3	04-01	10.3
	04-02	10.4	10.4	04-02	10.4	04-02	10.4
	04-03	10.5	10.5	04-03	10.5	04-03	10.5
	04-04	10.6	10.6	04-04	10.6	04-04	10.6
	04-05	10.7	10.7	04-05	10.7	04-05	10.7
	04-06	10.8	10.8	04-06	10.8	04-06	10.8
	04-07	10.9	10.9	04-07	10.9	04-07	10.9
	04-08	11.0	11.0	04-08	11.0	04-08	11.0
	04-09	11.1	11.1	04-09	11.1	04-09	11.1
	04-10	11.2	11.2	04-10	11.2	04-10	11.2
	04-11	11.3	11.3	04-11	11.3	04-11	11.3
	04-12	11.4	11.4	04-12	11.4	04-12	11.4
	04-13	11.5	11.5	04-13	11.5	04-13	11.5
	04-14	11.6	11.6	04-14	11.6	04-14	11.6
	04-15	11.7	11.7	04-15	11.7	04-15	11.7
	04-16	11.8	11.8	04-16	11.8	04-16	11.8
	04-17	11.9	11.9	04-17	11.9	04-17	11.9
	04-18	12.0	12.0	04-18	12.0	04-18	12.0
	04-19	12.1	12.1	04-19	12.1	04-19	12.1
	04-20	12.2	12.2	04-20	12.2	04-20	12.2
	04-21	12.3	12.3	04-21	12.3	04-21	12.3
	04-22	12.4	12.4	04-22	12.4	04-22	12.4
	04-23	12.5	12.5	04-23	12.5	04-23	12.5
	04-24	12.6	12.6	04-24	12.6	04-24	12.6
	04-25	12.7	12.7	04-25	12.7	04-25	12.7
	04-26	12.8	12.8	04-26	12.8	04-26	12.8
	04-27	12.9	12.9	04-27	12.9	04-27	12.9
	04-28	13.0	13.0	04-28	13.0	04-28	13.0
	04-29	13.1	13.1	04-29	13.1	04-29	13.1
	04-30	13.2	13.2	04-30	13.2	04-30	13.2
	05-01	13.3	13.3	05-01	13.3	05-01	13.3
	05-02	13.4	13.4	05-02	13.4	05-02	13.4
	05-03	13.5	13.5	05-03	13.5	05-03	13.5
	05-04	13.6	13.6	05-04	13.6	05-04	13.6
	05-05	13.7	13.7	05-05	13.7	05-05	13.7
	05-06	13.8	13.8	05-06	13.8	05-06	13.8
	05-07	13.9	13.9	05-07	13.9	05-07	13.9
	05-08	14.0	14.0	05-08	14.0	05-08	14.0
	05-09	14.1	14.1	05-09	14.1	05-09	14.1
	05-10	14.2	14.2	05-10	14.2	05-10	14.2
	05-11	14.3	14.3	05-11	14.3	05-11	14.3
	05-12	14.4	14.4	05-12	14.4	05-12	14.4
	05-13	14.5	14.5	05-13	14.5	05-13	14.5
	05-14	14.6	14.6	05-14	14.6	05-14	14.6
	05-15	14.7	14.7	05-15	14.7	05-15	14.7
	05-16	14.8	14.8	05-16	14.8	05-16	14.8
	05-17	14.9	14.9	05-17	14.9	05-17	14.9
	05-18	15.0	15.0	05-18	15.0	05-18	15.0
	05-19	15.1	15.1	05-19	15.1	05-19	15.1
	05-20	15.2	15.2	05-20	15.2	05-20	15.2
	05-21	15.3	15.3	05-21	15.3	05-21	15.3
	05-22	15.4	15.4	05-22	15.4	05-22	15.4
	05-23	15.5	15.5	05-23	15.5	05-23	15.5
	05-24	15.6	15.6	05-24	15.6	05-24	15.6
	05-25	15.7	15.7	05-25	15.7	05-25	15.7
	05-26	15.8	15.8	05-26	15.8	05-26	15.8
	05-27	15.9	15.9	05-27	15.9	05-27	15.9
	05-28	16.0	16.0	05-28	16.0	05-28	16.0
	05-29	16.1	16.1	05-29	16.1	05-29	16.1
	05-30	16.2	16.2	05-30	16.2	05-30	16.2
	05-31	16.3	16.3	05-31	16.3	05-31	16.3
	06-01	16.4	16.4	06-01	16.4	06-01	16.4
	06-02	16.5	16.5	06-02	16.5	06-02	16.5
	06-03	16.6	16.6	06-03	16.6	06-03	16.6
	06-04	16.7	16.7	06-04	16.7	06-04	16.7
	06-05	16.8	16.8	06-05	16.8	06-05	16.8
	06-06	16.9	16.9	06-06	16.9	06-06	16.9
	06-07	17.0	17.0	06-07	17.0		

TABLE 12

RECAPITULATION OF SLOPES FOR TEST 1

<u>STUDENT</u>	<u>01-05</u>	<u>10-14</u>	<u>20-24</u>	<u>30-34</u>	<u>40-44</u>	<u>50-54</u>	<u>60-64</u>
1	.430	.434	.450	.459	.549	.474	.460
2	.458	.475	.451	.492	.432	.442	.450
3	.423	.438	.409	.392	.421	.414	.425
4	.439	.502	.449	.446	.458	.402	.426
5	.482	.521	.484	.489	.539	.471	.443
6	.470	.435	.458	.449	.450	.424	.429
7	.541	.498	.481	.479	.485	.495	.453
8	.454	.389	.486	.380	.372	.366	.398
9	.510	.481	.438	.500	.388	.466	.456
"t" value		.210	1.000	.316	.160	.913	1.625

For seven degrees of freedom "t" is ^{2.145}2.365 at 5% level.

TABLE 12

1. ESTIMATION OF PROBABILITIES

00-00	00-05	00-10	00-15	00-20	00-25	00-30	THROUGH
000.	005.	010.	015.	020.	025.	030.	1
005.	010.	015.	020.	025.	030.	035.	2
010.	015.	020.	025.	030.	035.	040.	3
015.	020.	025.	030.	035.	040.	045.	4
020.	025.	030.	035.	040.	045.	050.	5
025.	030.	035.	040.	045.	050.	055.	6
030.	035.	040.	045.	050.	055.	060.	7
035.	040.	045.	050.	055.	060.	065.	8
040.	045.	050.	055.	060.	065.	070.	9
045.	050.	055.	060.	065.	070.	075.	10
050.	055.	060.	065.	070.	075.	080.	11
055.	060.	065.	070.	075.	080.	085.	12
060.	065.	070.	075.	080.	085.	090.	13
065.	070.	075.	080.	085.	090.	095.	14
070.	075.	080.	085.	090.	095.	1.000	15

For values of "x" less than 15, the probability is given in the table.

TABLE 13

RECAPITULATION OF SLOPES FOR TEST 2

<u>STUDENT</u>	<u>01-05</u>	<u>10-14</u>	<u>20-24</u>	<u>30-34</u>	<u>40-44</u>	<u>50-54</u>	<u>60-64</u>
1	.602	.612	.600	.622	.596	.637	.621
2	.634	.619	.589	.580	.590	.625	.535
3	.575	.519	.492	.528	.496	.551	.475
4	.666	.735	.638	.625	.600	.629	.640
5	.709	.682	.639	.633	.584	.602	.677
6	.727	.766	.700	.703	.600	.636	.617
7	.498	.711	.706	.662	.784	.625	.648
8	.490	.422	.559	.685	.508	.742	.686
9	.555	.624	.609	.623	.625	.601	.644
"t" value		.325	.800	.688	1.862	.963	1.000

For ^{Twelve}six degrees of freedom "t" is ^{2.179}2.447 at 5% level.

TABLE 13

POPULATION OF STATES FOR 1900

1900	1900	1900	1900	1900	1900	1900	1900
134.	733.	243.	323.	400.	313.	303.	1
233.	633.	033.	030.	333.	313.	333.	2
273.	133.	333.	333.	333.	313.	373.	3
333.	333.	303.	333.	333.	333.	333.	4
373.	333.	333.	333.	333.	333.	373.	5
413.	333.	300.	333.	333.	333.	413.	6
453.	333.	333.	333.	333.	333.	453.	7
493.	333.	333.	333.	333.	333.	493.	8
533.	333.	333.	333.	333.	333.	533.	9
573.	333.	333.	333.	333.	333.	573.	10

For the purpose of this table, the population of the United States is taken as 100,000,000.

TABLE 14

RECAPITULATION OF SLOPES FOR TEST 3

<u>STUDENT</u>	<u>01-05</u>	<u>10-14</u>	<u>20-24</u>	<u>30-34</u>	<u>40-44</u>	<u>50-54</u>	<u>60-64</u>
1	.734	.736	.660	.628	.622	.668	.674
2	.531	.619	.609	.584	.549	.562	.528
3	.718	.703	.669	.689	.689	.767	.839
4	.618	.810	.708	.688	.687	.747	.787
5	.651	.756	.690	.689	.656	.599	.625
6	.823	.833	.849	.841	.916	.925	1.006
7	.905	.642	.840	.814	.789	.821	.788
8	.567	.595	.443	.611	.501	.614	.497
9	.704	.731	.695	.739	.698	.699	.664
"t" value		.388	.098	.020	.158	.237	.433

For seven degrees of freedom "t" is ^{2.145}2.365 at 5% level.

TABLE 1A

COMPARATIVE OF DATA FOR 1957

1957-58	1956-57	1955-56	1954-55	1953-54	1952-53	1951-52	1950-51	1949-50
146.	200.	222.	220.	200.	207.	224.	224.	1
222.	222.	222.	222.	200.	212.	222.	222.	2
222.	222.	222.	222.	222.	222.	222.	222.	3
222.	222.	222.	222.	222.	222.	222.	222.	4
222.	222.	222.	222.	222.	222.	222.	222.	5
222.	222.	222.	222.	222.	222.	222.	222.	6
222.	222.	222.	222.	222.	222.	222.	222.	7
222.	222.	222.	222.	222.	222.	222.	222.	8
222.	222.	222.	222.	222.	222.	222.	222.	9
222.	222.	222.	222.	222.	222.	222.	222.	10

For further details of figures see Table 1A in Volume 1 of the Report.

TABLE 15

RECAPITULATION OF PERCENTAGES FOR TEST 1

<u>STUDENT</u>	<u>01-05</u>	<u>10-14</u>	<u>20-24</u>	<u>30-34</u>	<u>40-44</u>	<u>50-54</u>	<u>60-64</u>
1	100	101	105	107	128	110	107
2	100	104	98	107	94	97	98
3	100	104	97	93	100	98	100
4	100	114	102	102	104	92	97
5	100	108	100	101	112	98	92
6	100	93	97	96	96	90	91
7	100	92	89	88	90	92	84
8	100	86	107	84	82	81	88
9	100	94	86	98	76	91	89
"t" value		.455	1.444	.427	.000	1.734	2.061

For seven degrees of freedom "t" is 2.365 at 5% level.

TABLE 12

REGISTRATION OF PERSONNEL FOR TEST 1

STUDENT	01-01	10-10	10-11	10-12	10-13	10-14	10-15
1	100	101	101	101	101	101	101
2	100	101	101	101	101	101	101
3	100	101	101	101	101	101	101
4	100	101	101	101	101	101	101
5	100	101	101	101	101	101	101
6	100	101	101	101	101	101	101
7	100	101	101	101	101	101	101
8	100	101	101	101	101	101	101
9	100	101	101	101	101	101	101
10	100	101	101	101	101	101	101
11	100	101	101	101	101	101	101
12	100	101	101	101	101	101	101
13	100	101	101	101	101	101	101
14	100	101	101	101	101	101	101
15	100	101	101	101	101	101	101
16	100	101	101	101	101	101	101
17	100	101	101	101	101	101	101
18	100	101	101	101	101	101	101
19	100	101	101	101	101	101	101
20	100	101	101	101	101	101	101
21	100	101	101	101	101	101	101
22	100	101	101	101	101	101	101
23	100	101	101	101	101	101	101
24	100	101	101	101	101	101	101
25	100	101	101	101	101	101	101
26	100	101	101	101	101	101	101
27	100	101	101	101	101	101	101
28	100	101	101	101	101	101	101
29	100	101	101	101	101	101	101
30	100	101	101	101	101	101	101
31	100	101	101	101	101	101	101
32	100	101	101	101	101	101	101
33	100	101	101	101	101	101	101
34	100	101	101	101	101	101	101
35	100	101	101	101	101	101	101
36	100	101	101	101	101	101	101
37	100	101	101	101	101	101	101
38	100	101	101	101	101	101	101
39	100	101	101	101	101	101	101
40	100	101	101	101	101	101	101
41	100	101	101	101	101	101	101
42	100	101	101	101	101	101	101
43	100	101	101	101	101	101	101
44	100	101	101	101	101	101	101
45	100	101	101	101	101	101	101
46	100	101	101	101	101	101	101
47	100	101	101	101	101	101	101
48	100	101	101	101	101	101	101
49	100	101	101	101	101	101	101
50	100	101	101	101	101	101	101
51	100	101	101	101	101	101	101
52	100	101	101	101	101	101	101
53	100	101	101	101	101	101	101
54	100	101	101	101	101	101	101
55	100	101	101	101	101	101	101
56	100	101	101	101	101	101	101
57	100	101	101	101	101	101	101
58	100	101	101	101	101	101	101
59	100	101	101	101	101	101	101
60	100	101	101	101	101	101	101
61	100	101	101	101	101	101	101
62	100	101	101	101	101	101	101
63	100	101	101	101	101	101	101
64	100	101	101	101	101	101	101
65	100	101	101	101	101	101	101
66	100	101	101	101	101	101	101
67	100	101	101	101	101	101	101
68	100	101	101	101	101	101	101
69	100	101	101	101	101	101	101
70	100	101	101	101	101	101	101
71	100	101	101	101	101	101	101
72	100	101	101	101	101	101	101
73	100	101	101	101	101	101	101
74	100	101	101	101	101	101	101
75	100	101	101	101	101	101	101
76	100	101	101	101	101	101	101
77	100	101	101	101	101	101	101
78	100	101	101	101	101	101	101
79	100	101	101	101	101	101	101
80	100	101	101	101	101	101	101
81	100	101	101	101	101	101	101
82	100	101	101	101	101	101	101
83	100	101	101	101	101	101	101
84	100	101	101	101	101	101	101
85	100	101	101	101	101	101	101
86	100	101	101	101	101	101	101
87	100	101	101	101	101	101	101
88	100	101	101	101	101	101	101
89	100	101	101	101	101	101	101
90	100	101	101	101	101	101	101
91	100	101	101	101	101	101	101
92	100	101	101	101	101	101	101
93	100	101	101	101	101	101	101
94	100	101	101	101	101	101	101
95	100	101	101	101	101	101	101
96	100	101	101	101	101	101	101
97	100	101	101	101	101	101	101
98	100	101	101	101	101	101	101
99	100	101	101	101	101	101	101
100	100	101	101	101	101	101	101

For every student of Test 1, the value of the test is 1.000.

TABLE 16

RECAPITULATION OF PERCENTAGES FOR TEST 2

<u>STUDENT</u>	<u>01-05</u>	<u>10-14</u>	<u>20-24</u>	<u>30-34</u>	<u>40-44</u>	<u>50-54</u>	<u>60-64</u>
1	100	102	100	103	99	106	103
2	100	98	93	91	93	99	84
3	100	90	86	92	86	96	83
4	100	110	96	94	90	94	96
5	100	96	90	89	82	85	95
6	100	105	96	97	82	88	85
7	100	143	142	133	157	126	130
8	100	86	114	140	104	151	140
9	100	112	110	112	113	108	116
"t" value		.626	2.185	1.025	1.947	1.050	1.193

For six degrees of freedom "t" is 2.447 at 5% level.

TABLE 10

PERCENTAGE OF FERTILIZATION FOR EACH

PERCENTAGE	10-15	16-20	21-25	26-30	31-35	36-40	41-45
1	100	100	100	100	100	100	100
2	100	100	100	100	100	100	100
3	100	100	100	100	100	100	100
4	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100
11	100	100	100	100	100	100	100
12	100	100	100	100	100	100	100
13	100	100	100	100	100	100	100
14	100	100	100	100	100	100	100
15	100	100	100	100	100	100	100
16	100	100	100	100	100	100	100
17	100	100	100	100	100	100	100
18	100	100	100	100	100	100	100
19	100	100	100	100	100	100	100
20	100	100	100	100	100	100	100
21	100	100	100	100	100	100	100
22	100	100	100	100	100	100	100
23	100	100	100	100	100	100	100
24	100	100	100	100	100	100	100
25	100	100	100	100	100	100	100
26	100	100	100	100	100	100	100
27	100	100	100	100	100	100	100
28	100	100	100	100	100	100	100
29	100	100	100	100	100	100	100
30	100	100	100	100	100	100	100
31	100	100	100	100	100	100	100
32	100	100	100	100	100	100	100
33	100	100	100	100	100	100	100
34	100	100	100	100	100	100	100
35	100	100	100	100	100	100	100
36	100	100	100	100	100	100	100
37	100	100	100	100	100	100	100
38	100	100	100	100	100	100	100
39	100	100	100	100	100	100	100
40	100	100	100	100	100	100	100
41	100	100	100	100	100	100	100
42	100	100	100	100	100	100	100
43	100	100	100	100	100	100	100
44	100	100	100	100	100	100	100
45	100	100	100	100	100	100	100
46	100	100	100	100	100	100	100
47	100	100	100	100	100	100	100
48	100	100	100	100	100	100	100
49	100	100	100	100	100	100	100
50	100	100	100	100	100	100	100
51	100	100	100	100	100	100	100
52	100	100	100	100	100	100	100
53	100	100	100	100	100	100	100
54	100	100	100	100	100	100	100
55	100	100	100	100	100	100	100
56	100	100	100	100	100	100	100
57	100	100	100	100	100	100	100
58	100	100	100	100	100	100	100
59	100	100	100	100	100	100	100
60	100	100	100	100	100	100	100
61	100	100	100	100	100	100	100
62	100	100	100	100	100	100	100
63	100	100	100	100	100	100	100
64	100	100	100	100	100	100	100
65	100	100	100	100	100	100	100
66	100	100	100	100	100	100	100
67	100	100	100	100	100	100	100
68	100	100	100	100	100	100	100
69	100	100	100	100	100	100	100
70	100	100	100	100	100	100	100
71	100	100	100	100	100	100	100
72	100	100	100	100	100	100	100
73	100	100	100	100	100	100	100
74	100	100	100	100	100	100	100
75	100	100	100	100	100	100	100
76	100	100	100	100	100	100	100
77	100	100	100	100	100	100	100
78	100	100	100	100	100	100	100
79	100	100	100	100	100	100	100
80	100	100	100	100	100	100	100
81	100	100	100	100	100	100	100
82	100	100	100	100	100	100	100
83	100	100	100	100	100	100	100
84	100	100	100	100	100	100	100
85	100	100	100	100	100	100	100
86	100	100	100	100	100	100	100
87	100	100	100	100	100	100	100
88	100	100	100	100	100	100	100
89	100	100	100	100	100	100	100
90	100	100	100	100	100	100	100
91	100	100	100	100	100	100	100
92	100	100	100	100	100	100	100
93	100	100	100	100	100	100	100
94	100	100	100	100	100	100	100
95	100	100	100	100	100	100	100
96	100	100	100	100	100	100	100
97	100	100	100	100	100	100	100
98	100	100	100	100	100	100	100
99	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100

For all groups of people "1" is the best of the best.

TABLE 17

RECAPITULATION OF PERCENTAGES FOR TEST 3

<u>STUDENT</u>	<u>01-05</u>	<u>10-14</u>	<u>20-24</u>	<u>30-34</u>	<u>40-44</u>	<u>50-54</u>	<u>60-64</u>
1	100	100	90	86	85	91	92
2	100	117	115	110	103	106	99
3	100	98	93	96	96	107	117
4	100	131	115	111	111	121	127
5	100	116	106	106	101	92	96
6	100	101	103	102	111	112	122
7	100	71	93	90	87	91	87
8	100	105	78	108	88	108	88
9	100	104	99	105	99	99	94
"t" value		.760	.506	.230	.256	.609	.785

For seven degrees of freedom "t" is 2.365 at 5% level.

TABLE 17

RECAPITULATION OF RECOMMENDATIONS FOR FISCAL YEAR 1961

RECOMMENDATION	10-01	10-02	10-03	10-04	10-05	10-06	10-07
1	100	100	100	100	100	100	100
2	100	100	100	100	100	100	100
3	100	100	100	100	100	100	100
4	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100

For seven years of "C" or better service, 100% of the salary shall be paid.

APPENDIX A

Sample Calculation

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

$$\text{where } S_1^2 = \frac{1}{N_1 - 1} \left[\sum X_1^2 - \frac{(\sum X_1)^2}{N_1} \right]$$

$$\bar{X}_1 = \frac{\sum X_1}{N_1}$$

$$S_2^2 = \frac{1}{N_2 - 1} \left[\sum X_2^2 - \frac{(\sum X_2)^2}{N_2} \right]$$

$$\bar{X}_2 = \frac{\sum X_2}{N_2}$$

Test 1

Student	Slopes		Percentages	
	01-05	10-14	01-05	10-14
1	.430	.434	0	1
2	.458	.475	0	4
3	.423	.438	0	4
4	.439	.502	0	14
5	.482	.521	0	8
6	.470	.435	0	-7
7	.541	.498	0	-8
8	.510	.481	0	-6
$\sum X$	3.753	3.784	0	10
\bar{X}	.469	.473	0	1.25
$(\sum X)^2$	14.085009	14.3186556	0	100

	01-05	10-14	01-05	10-14
$\frac{(\sum X)^2}{N}$	1.760626	1.789832	0	12.5
$\sum X^2$	1.772319	1.797860	0	442.0
S^2	.001670	.001147	0	429.5
$\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}$.019		2.746
$\bar{X}_1 - \bar{X}_2$.004		1.25
t		.210		.455

01-01 02-02 03-03 04-04

0.11 0 0.11 0.11
0.11 0 0.11 0.11
0.11 0 0.11 0.11

0.11

0.11

0.11

0.11

0.11

0.11

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